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A new Foraminifera from the upper Middle Eocene of the Ebro Basin, Spain

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Abstract. ***Serraia cataloniensis*** **gen. et sp. nov. is differentiated from other pellatispiracean Foraminifera by the presence of one or more intercalary whorls of median chambers winding in the same direction as the primary whorl, and by frequent protoconchal and deureroconchal diverticula and a short spire of chambers around the deuteroconch.** ***S. cataloniensis*** **is described from the La Tossa Formation of the Bartonian regressive cycle of sedimentation in the Ebro Basin, Barcelona region, Spain.**

Key words: Bartonian regressive cycle, Ebro Bassin, La Tossa Formation, Late Bartonian, ***Serraia cataloniensis*****, Spain**

Introduction

At the second meeting of the IGCP 393, "Neritic Events at the Middle-Upper Eocene Boundary", in Vic, Spain, 2-6 September 1997, the field trip guided by Serra-Kiel *et al.* (1997) took us to different outcrops of Lutetian and Bartonian sediments in the Ebro Basin, southeastern Pyrenean Foreland Basin, Catalonia, Spain. The Puig Aguilera outcrop lies at 41°35′N. Lat. 1°39′E. Long., on the Puig Aguilera, a mountain 5 km northeast of the town of Igualada, 50 km northwest of Barcelona (Figure 1). The geologic section in the Puig Aguilera outcrop (Serra-Kiel *et al.*, 1997, p. 43, fig. 38; Figure 1) begins with marls alternating with sandstone beds in the lower sequence. Above this sequence, there is an interval of marls and sandstones alternating with limestone beds. Serra-Kiel et *al.* (1997) interpret the former as belonging to the upper part of the Bartonian transgressive facies of the La Tossa Formation (Ferrer, 1971), while the latter belongs to the Bartonian regressive facies of the same formation. Sample 4 at the Puig Aguilera outcrop is from the marls corresponding to the Bartonian regressive facies and is rich in larger foraminifers. Especially common are *Asterocyclina stellaris* (Brunner, 1848 MS., in Rütimeyer, 1850), *Discocyclina pratti* (Michelin, 1946), *D. sella* (d'Archiac, 1850), *Heterostegina reticulata* Rütimeyer, 1850, *Operculina schwageri* Silvestri, 1928, *Pellatispira madaraszi* (Hantken, 1875), *Orbitocliypeus* sp., and *Nummulites* sp.

The regressive facies of the Bartonian cycle occurs in the Igualada and Vic areas, eastern Ebro Basin, Barcelona region, and changes laterally. The facies of the La Tossa Formation in the Igualada area is correlated to the Saint Marti Xic Limestone Formation (Reguant, 1967) represented by deltaic and reef sediments in the Vic area. On top of the deltaic-reef complex of the Bartonian regressive cycle and below the evaporitic sediments of the Cardona Formation (Riba, 1975) in the Igualada and Vic areas, there is a Terminal Complex, named by Trave (1992), which reflects the change from marine to continental sedimentation. The Terminal Complex corresponds to the magnetostratigraphic scale from 17.2 to 17.1, and to planktonic foraminiferal Zone P. 15 of Berggren *et al.* (1995). Thus the age of the Bartonian regressive facies of the Bartonian marine sediments in the Igualada and Vic areas is regarded as Late Bartonian.

One of the major achievements of project IGCP 393 was the identification of additional larger foraminifers. *Serraia cataloniensis* gen. et sp. nov. occurs in marls in sample 4, which Dr. Serra-Kiel kindly sent to the author for study, and is found there in association with *Biplanispira mirabilis* (Umbgrove, 1937) and the foraminifers listed above.

Systematic paleontology

Order Foraminiferida
Suborder Rotaliina
Superfamily Nummulitacea
Family Pellatispiridae Hanzawa, 1937

Remarks.—In addition to the type genus, Matsumaru (1996a, p. 110-118) assigned the genus *Biplanispira* Umbgrove, 1937 to the family Pellatispiridae Hanzawa, 1937, because of its characteristic planispiral to low trochospiral coiling, subsutural and intraseptal radial canals, vertical canals or fissures, and no marginal cord, following Loeblich and Tappan's (1987) classification. Also Matsumaru (1996a) emended the diagnosis of the family such that the secondary and surface chambers are differentiated from the spiral and umbilical sides of the test. Moreover Matsumaru (1996b) transferred the genus *Bolkarina* Sirel, 1981 to the family

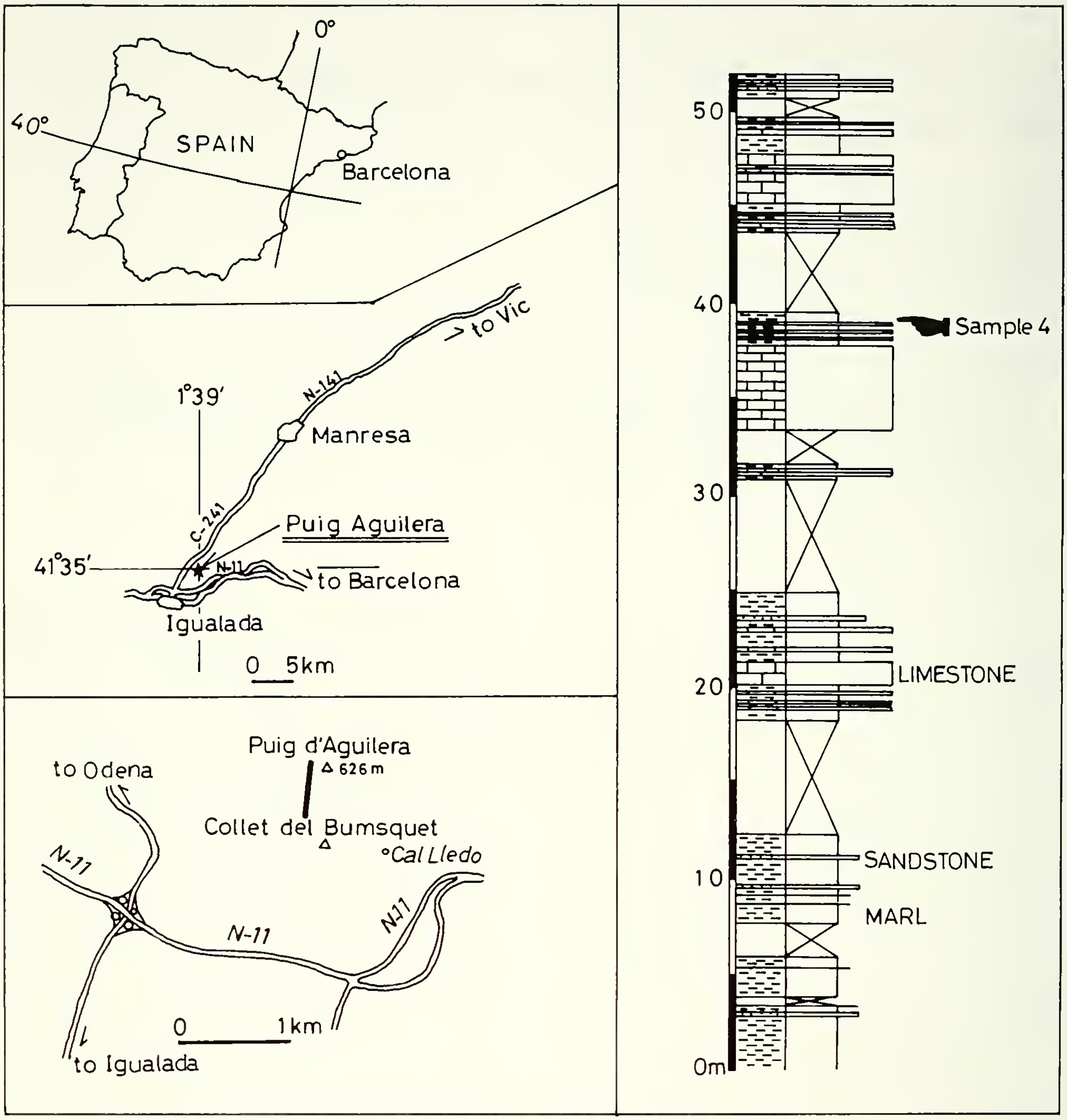


Figure 1. Geographic and stratigraphic position of sample locality (sample 4) from Puig Aguilera outcrop, Igualada City, northwest of Barcelona, Spain.

Discocyclinidae Galloway, 1928 from the family Pellatispiridae.

Genus *Serraia* gen. nov.

Type species.—*Serraia cataloniensis* sp. nov.

Diagnosis.—A pellatispiriid genus characterized by remarkable development of secondary and tertiary spiral chambers of intercalary whorls in early growth stage of planispiral to low trochospiral whorl of primary spiral chambers, and by frequent presence of protochoncal and deuteroconchal diverticula and short spiral chambers around deuteroconch.

Description.—Test lenticula, bilaterally symmetrical in outline with granules extending to pillars distributed rather spirally over surface of test; bilocular embryo of protoconch and deuteroconch frequently containing protoconchal and deuteroconchal diverticula, and a short spire of small chambers around deuteroconch, followed by a primary coil of loosely evolute, later becoming involute whorls of large spiral chambers (i. e. primary spiral chambers), together with secondary and tertiary intercalary whorls of small spiral chambers (i. e. secondary and tertiary spiral chambers) added between whorls of primary coil; all chambers connected by a basal foramen with intraseptal, subsutural and rather canals, winding in same direction as primary whorls towards periphery of test; later primary spiral chambers subdivided into irregularly arranged spiral chambers at peripheral part of test as seen in *Biplanispira*. Lateral layers thickest at center and gradually attenuated towards periphery of test, pierced by numerous vertical pores opening between numerous pillars embeded in lateral layers, and by numerous vertical and radial canals; vertical pores opening covered by thin and finely cribrate roofs of small surface chambers. Test wall calcareous, thick, fibrous and lamellar with two layers of fibrous structure, inner one thin and compact, and outer one thick and coarsely perforate.

Etymology.—The genus name is after Dr. Josep Serra-Kiel, who provided the pellatispiracean-bearing sample in this study.

Stratigraphic horizon.—Upper part of the La Tossa Formation.

Comparison.—The present genus resembles the genus *Biplanispira* Umbgrove by the presence of a single median layer of primary spiral chambers, and later bifurcating layers of spirally disposed chambers. However, *Serraia* is distinguished from *Biplanispira* in having the second and third median layers of chambers developed from the third and fourth chambers of the primary spiral chambers, respectively, which wind in the same direction as the primary whorl, and also in having frequent protoconchal and deuteroconchal diverticula and a short single layer of chambers around the deuteroconch. *Serraia* resembles *Dictyoconoides* Nuttall, 1925 and *Dictyokathina* Smout, 1954 in having median chambers formed by repeated doubling (originated from bilocular embryonic and median chambers) and in having a test wall with fibrous, lamellar structure that is pierced by vertical canals. However, this new genus is distinguished from them in having double median chambers originated from the primary spiral chambers in an early nepionic stage, in having median layers of fibrous structure, and in lacking an umbilical mass of numerous pillars. Moreover, *Serraia* is distinguished from the genus *Boninella* Matsumaru, 1996a in having chamber layers with fibrous and lamellar structure.

Serraia cataloniensis sp. nov.

Figures 2-1—3; 3-1—5; 4-1—3; 5-1—3

Material.—Holotype: a megalospheric specimen in a half test, Saitama University coll. no. 8841 (Figures 2-1; 3-1); Paratype: equatorial sections of megalospheric specimens, Saitama University coll. no. 8842 (Figures 2-2; 3-5), Saitama

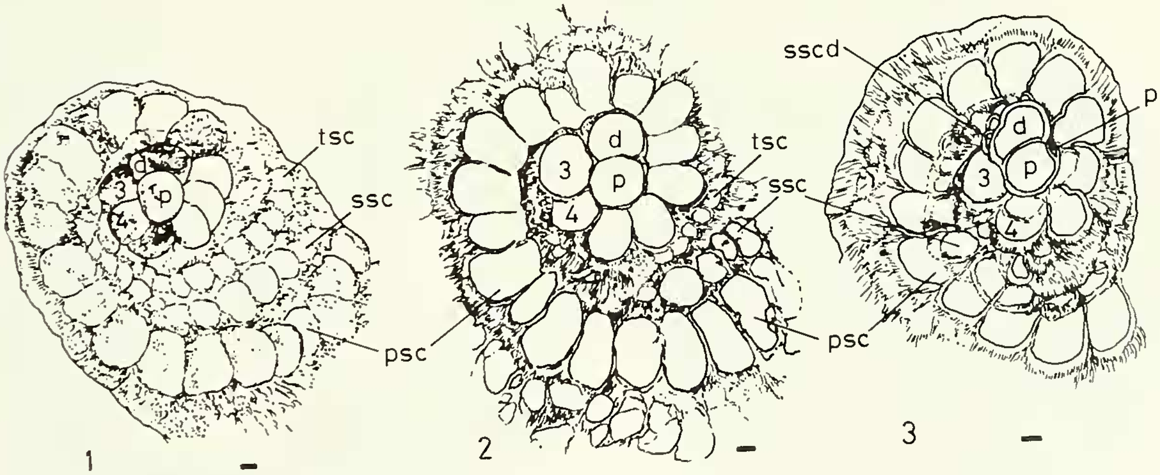
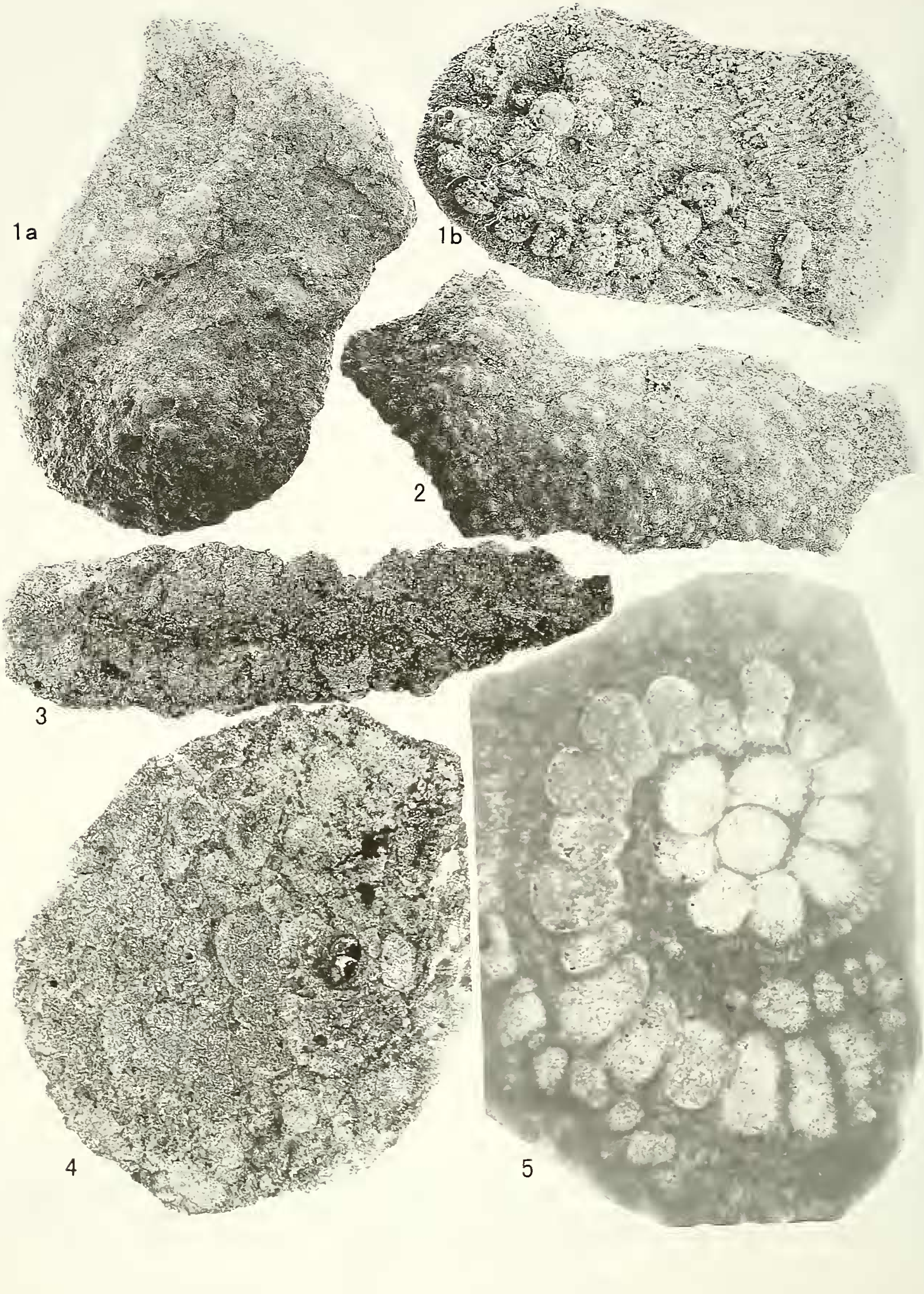


Figure 2. *Serraia cataloniensis* gen. et sp. nov. Drawings of megalospheric specimens. **1.** Holotype, Saitama University coll. no. 8841 (see also Figure 3-1). **2.** Paratype (see also Figure 3-5), Saitama University coll. no. 8842. 3. Paratype (see also Figure 5-2), Saitama University coll. no. 8843. Abbreviations: p = protoconch; pd = protoconchal diverticulum; d = deuteroconch; 3, 4 = third and fourth primary spiral chambers; psc = primary spiral chambers; ssc = secondary spiral chambers; tsc = tertiary spiral chambers; sscd = short spiral chambers around deuteroconch. Scale bars = 100 μm.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University coll. no. 8843 (Figures 2-3 ; 5-2), Saitama University coll. no. 8846 (Figure 5-1), Saitama University coll. no. 8847 (Figures 5-3a-b), and Saitama University coll. no. 8850 (Figure 3-4) ; Paratype : test surface and/or equatorial views of megalospheric or microspheric specimens, Saitama University coll. no. 8844 (Figures 4-1a-c), Saitama University coll. no. 8845 (Figures 4-2a-b), Saitama University coll. no. 8848 (Figure 3-2) and Saitama University coll. no. 8851 (Figures 4-3a-b) ; Paratype : vertical sections of megalospheric specimen, Saitama University coll. no. 8849 (Figure 3-3).

Description.—Test thin (0.6 to 0.9 mm in thickness), lenticular (2.0 to 4.0 mm in diameter) with rather thick marginal periphery ; form ratio (diameter/thickness) 4.0 to 7.7 in megalospheric form ; and 9.0 in single microspheric form observed which is 4.5 mm in diameter. Megalospheric embryonic chambers biloculine ; subspherical to spherical protoconch ranging from 160×140 to 370×370 μm in diameter in seven specimens, and reniform deuteroconch 200×160 to 430×370 μm in diameter in seven specimens ; whole embryonic chambers 320 to 600 μm in diameter across both protoconch and deuteroconch in seven specimens ; outer wall of embryonic chambers 20 to 30 μm thick in seven specimens ; third primary spiral chamber 100×120 to 265×350 μm in radial and tangential diameters in seven specimens ; and fourth primary spiral chamber 60×120 to 240×215 μm in radial and tangential diameters in seven specimens. Other primary spiral chambers developed into a planispirally to low trochospirally evolute whorl in mature stage and into involute whorl in gerontic stage ; first whorl divided by septa into 7 to 10 chambers, first whorl and a half with 15 to 20 chambers, and second whorl with 25 ? to 33 ? chambers in seven specimens. Secondary spiral chambers of second median layer in planispiral to low trochospiral whorl 60×100 to 220×240 μm in maximum radial and tangential diameters in seven specimens. Tertiary spiral chambers of third median layer in planispiral to low trochospiral whorl 100×200 to 200×130 μm in maximum radial and tangential diameters in five specimens ; both secondary and tertiary spiral chambers wind in same direction as primary spiral chambers. Median layer of primary spiral chambers subdivided into irregularly arranged, spiral chamber layers towards periphery. Protoconchal diverticula arcuate, 28×42 to 30×62 μm in radial and tangential diameters in three specimens, and deuteroconchal diverticula arcuate 80 ?×140 ? μm and 83×145 μm in radial and tangential diameters in two specimens. Short spiral chambers around deuteroconch frequently present and arcuate, 25×62 to 40×93 μm in maximum radial and tangential diameters in two specimens. Lateral layers thickest at center and attenuated towards periphery of test, and pierced by numerous open pores or vertical canals of 8 to 20 μm diameter. Pore openings covered by thin roofs of small surface chambers with 135×38 to 145×40 μm in maximum tangential diameter and height in three specimens. Test wall thick, fibrous, and perforate ; canal system showing radial, simple and marginal, and intraseptal canal present. Dorsal and umbilical pillars present over lateral walls ; smaller ones 85 to 100 μm in diameter, and larger ones 135 to 185 μm in diameter. Aperture with longitudinal grooves on base of apertural face ; in present material, measurements of seven megalospheric forms given in Table 1.

Etymology.—The species name is derived from the province of Catalonia, Spain.

Type locality.—Sample locality (Sample 4) of Puig Aguilera outcrop, Igualada, 50 km northwest of Barcelona, Spain (Figure 1).

Remarks.—*Serraia cataloniensis* sp. nov. resembles *Biplanispira mirabilis* (Umbgrove, 1936), but is easily distinguished from the latter in having the secondary and tertiary spiral chambers developed in the same direction as the primary spiral chambers, and in posessing frequent protoconchal and deuteroconchal diverticula and short spiral chambers around the deuteroconch. The author considers that this new species may have evolved from *Biplanispira mirabilis* (Umbgrove) by developing secondary and tertiary spiral chambers directly from the spiral chambers.

Acknowledgments

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← **Figure 3.** *Serraia cataloniensis* gen. et sp. nov. **1a.** External view (spiral side) of megalospheric specimen (holotype), showing large- and small-sized granules, and rather thick marginal periphery of test. **1b.** Equatorial and internal view of holotype showing embryonic chambers with half-broken deuteroconch ; primary spiral chambers with 5th, 9th and 12th broken chambers, and secondary and tertiary spiral chambers, all coiling in same direction except for peripheral chambers. ×26. **2.** External view of spiral side of test in microspheric specimen, paratype, Saitama University coll. no. 8848, ×22. **3.** Vertical section of megalospheric specimen, paratype, Saitama University coll. no. 8849, showing spiral and surface chambers, lateral layers thickest at center and attenuated towards periphery, large and small pillars, pore openings, and canals, ×43. **4.** Eqautorial section of broken specimen, paratype, Saitama University coll. no. 8850, showing irregularly-arranged primary spiral chambers towards periphery of test, coiling opposite direction to primary whorl as seen in *Biplanispira*, and also coiling in same direction as primary whorl, ×43. **5.** Equatorial section of megalospheric specimen, paratype, Saitama University coll. no. 8842, showing embryonic chambers, primary spiral chambers, and secondary and tertiary spiral chambers, all coiling in same direction, ×40.

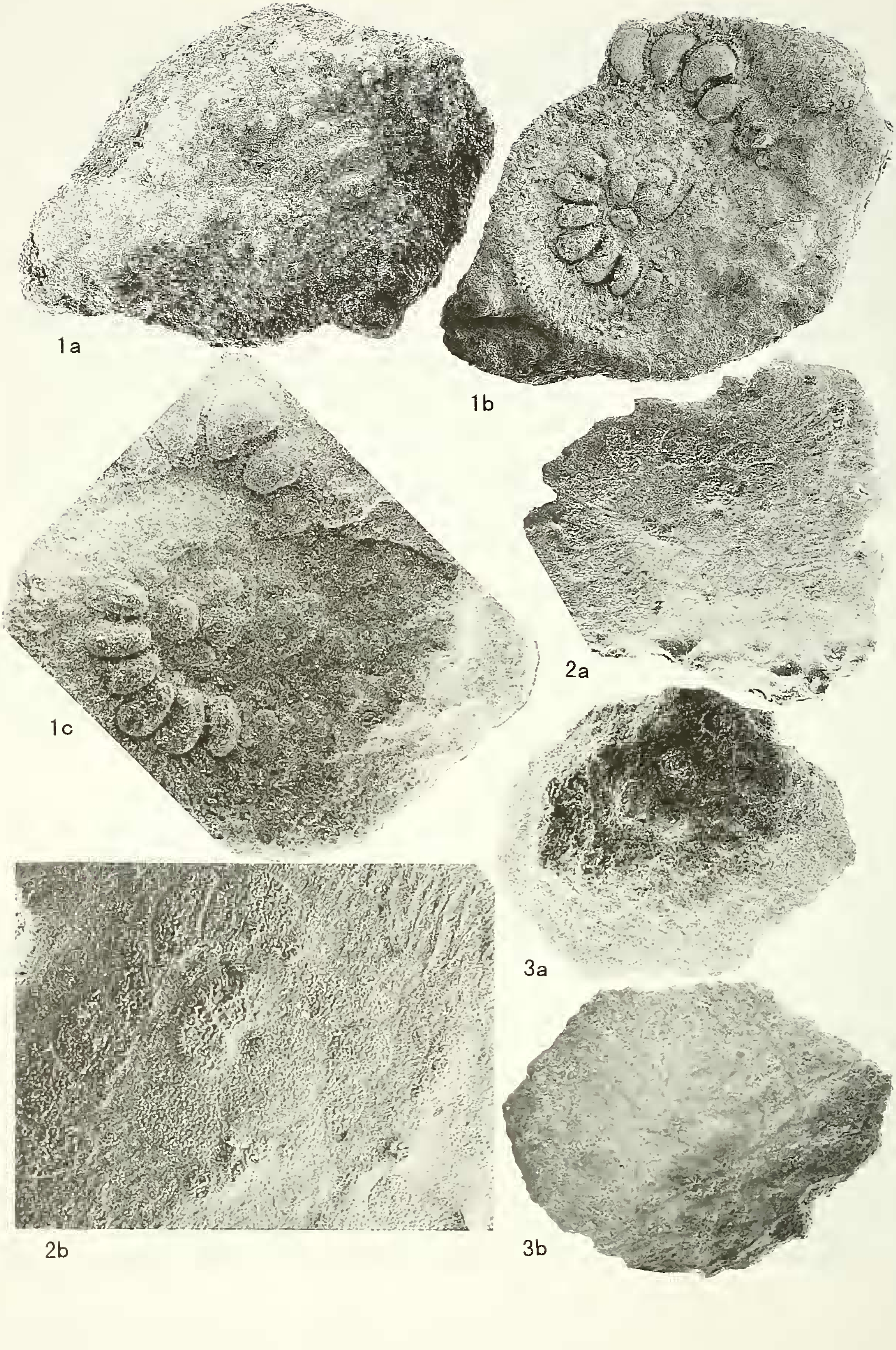
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Table 1. Measurements of internal equatorial view and equatorial sections of *Serraia cataloniensis* sp. nov.

Specimen	Holotype no. 8841 (Fig. 3-1)	Paratype no. 8842 (Fig. 3-5)	Paratype no. 8843 (Fig. 5-2)	Paratype no. 8846 (Fig. 5-1)	Paratype no. 8847 (Fjg. 5-3)	Paratype no. 8844 (Fig. 4-1)	Paratype no. 8845 (Fig. 4-2)
Diameter (mm)	3.6	3.1	2.3	3.0	3.0	4.0	2.0
Thickness (mm)	0.9	0.6	0.3	0.4	0.5	0.9	0.3
Form ratio (diameter/thickness)	4.0	5.2	7.7	7.5	6.0	4.4	6.7
Embryonic chambers							
protoconch diameter (μm)	370×370	350×290	302×272	235×265	360×250	220×140	160×140
deuteroconch diameter (μm)	374×212	320×208	350×230	235×170	430×340	220×160	200×160
distance across both chambers (μm)	600	498	502	435	600	320	320
wall thickness (μm)	30	30	20	28	30	28	22
Protoconchal diverticula							
radial diameter (μm)			30	30	28		
tangential diameter (μm)			62	42	42		
Deuteroconchal diverticula							
radial diameter (μm)				80 ?	83		
tangential diameter (μm)				140 ?	145		
Spiral chambers around deuteroconch							
radial diameter (μm)			33 40 40		25 33		
tangential diameter (μm)			72 52 93		62 40		
Primary spiral chambers							
Third chamber							
radial diameter (μm)	145	265	208	100	220	135	100
tangential diameter (μm)	280	350	290	140	290	165	120
Fourth chamber							
radial diameter (μm)	200	165	240	140	180	60	80
tangential diameter (μm)	160	145	215	140	220	120	110
number in 1st whorl	8	8	7	9	10	7	9
number in 1+1/2 whorl	16	18	15	17	18	15	18
number in 2nd whorl	30?	33?	28?	29	29?	29	25?
Secondary spiral chambers							
radial diameter (μm)	230	220	230	190	140	60	60
tangential diameter (μm)	160	240	230	200	186	100	100
Tertiary spiral chambers							
radial diameter (μm)	200	120	100	100		100	
tangential diameter (μm)	130	95	200	200		200	

← **Figure 4.** *Serraia cataloniensis* gen. et sp. nov. **1a.** External view of megalospheric specimen, paratype, Saitama University coll. no. 8844, in umbilical side of test, showing dextral distribution of large- and small-sized granules. **1b.** Equatorial and internal view of same specimen of Figure 4-1a, showing embryonic chambers, and primary, secondary and tertiary spiral chambers, all coiling in sinistral direction, ×26. **1c.** Central part of internal view of Figure 4-1b, showing embryonic and primary spiral chambers, and secondary and tertiary spiral chambers, ×43. **2a.** Equatorial and internal view of megalospheric specimen, paratype, Saitama University coll. no. 8845, ×43. **2b.** Central part of internal view in Figure 4-2a, showing embryonic and primary spiral chambers, and secondary spiral chambers connected by intraseptal, subsutural and radial canals from third chamber and 7 th chamber of primary spiral chambers, ×107. **3a.** External view of megalospheric specimen, paratype, saitama University coll. no. 8851, showing spiral side of test. **3b.** External view of same specimen as Figure 4-3a showing umbilical side of test, ×26.

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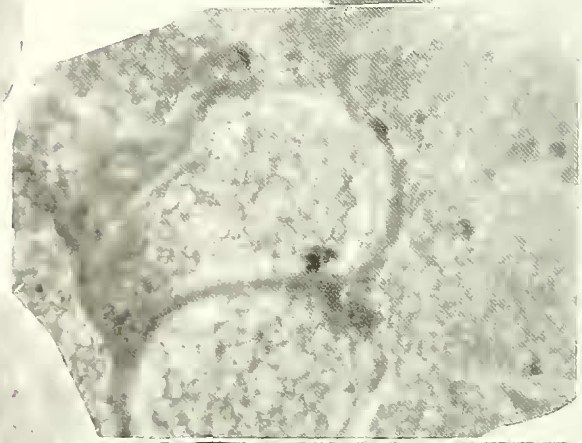
2a



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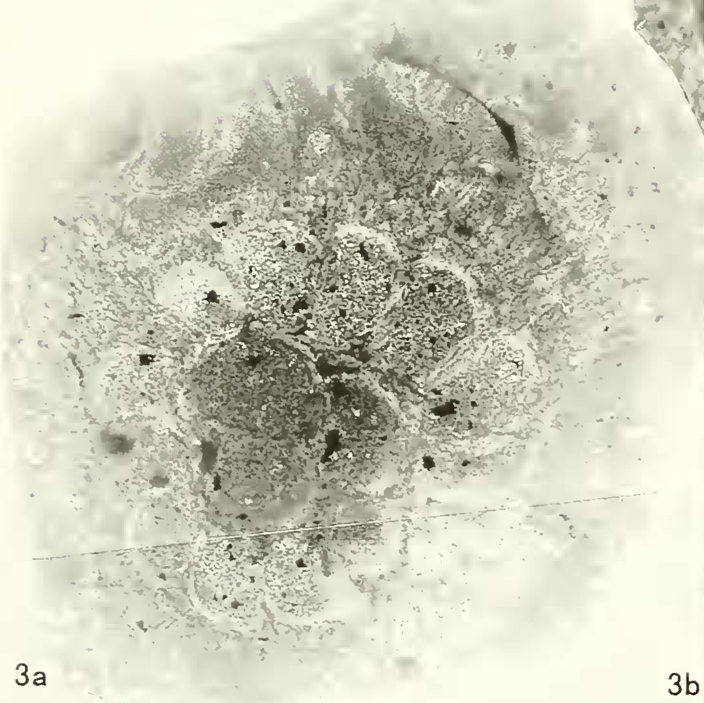

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3b

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← **Figure 5.** *Serraia cataloniensis* gen. et sp. nov. **1.** Equatorial section of megalospheric specimen, paratype, Saitama University coll. no. 8846, showing embryonic chambers, primary spiral chambers, and secondary and tertiary spiral chambers, all coiling in same direction, ×43. **2a.** Equatorial section of megalospheric specimen, paratype, Saitama University coll. no. 8843, showing embryonic and primary spiral chambers, secondary spiral chambers, protoconchal diverticulum, and short spiral chambers arranged deuteroconch, ×43. **2b.** Central part of equatorial section in Figure 5–2a, showing protoconchal diverticulum and short spiral chambers around deuteroconch connected by deuteroconchal stolons and probably intraseptal, subsutural and radial canals from third chamber, ×107. **3a.** Equatorial section of megalospheric specimen, paratype, Saitama University coll. no. 8847, showing embryonic, primary and secondary spiral chambers, deuteroconchal diverticulum, and short spiral chambers around deuteroconch, ×43. **3b.** Central part of equatorial section in Figure 5–3a, showing deuteroconchal diverticulum, and short spiral chambers connected by deuteroconchal stolons and intraseptal, subsutural and radial canals or stolons ? ×95.